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Physical And Physiological Characteristics Of Youth Football Players: A Comparative Study Of Kerala And Lakshadweep

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Abstract: This study aimed to compare the physical and physiological characteristics of youth football players aged 15–17 years from Kerala and Lakshadweep. A total of 200 male players (100 from each region) participated in this cross-sectional study. Anthropometric variables, body composition, physical performance (agility, sprint, power, and flexibility), and physiological capacities (intermittent endurance and aerobic fitness) were assessed using standardized field-based tests. Independent samples t-tests were used to determine differences between groups. The results revealed no significant differences in anthropometric characteristics between the groups. However, Kerala players demonstrated significantly better performance in agility, linear sprint, curve sprint, flexibility, and intermittent endurance. In contrast, Lakshadweep players exhibited significantly higher aerobic capacity (VO_2max). These findings suggest that while body composition remains comparable, performance-related attributes are influenced by region-specific factors such as training exposure and environmental conditions. The study highlights the importance of targeted training interventions to optimize performance in youth football players.

Index Terms - Football, Agility, Sprint, VO2max.

I. INTRODUCTION

Football is a non-physically demanding, high-intensity, intermittent activity that alternates periods of low-intensity exercise, such as walking and jogging, with rapid bursts of sprinting, acceleration, deceleration, and change of direction. Players must have a well-rounded combination of endurance, speed, strength, power, agility, and flexibility to meet the physical demands of the game.(Plakias et al., 2025; Silva et al., 2015). These characteristics are supported by complex motor skills that directly impact performance, training adaptation, and competition results. In modern football, the ability to consistently undertake high-intensity activities while maintaining technical and tactical efficiency is considered a critical predictor of success.(Hostrup & Bangsbo, 2023; Iaia et al., 2009).

These characteristics are supported by complex motor skills that directly impact performance, training adaptation, and competition results. In modern football, the ability to consistently undertake high-intensity activities while maintaining technical and tactical efficiency is considered a critical predictor of success.(Pillitteri et al., 2023; Ribeiro et al., 2020). Additionally, positional duties have a significant impact on these needs; For example, midfielders often cover large distances, while attackers and defenders engage in high-intensity activities such as sprinting and jumping. These variations emphasize the importance of analyzing physical and physiological characteristics in relation to performance and placement needs.(Chmura et al., 2018; Pillitteri et al., 2023; Ribeiro et al., 2020).

Anthropometric measurements, body composition characteristics, and athleticism-related qualities are essential for football. Variables such as body mass index (BMI), body fat percentage, fat-free mass, and flexibility are associated with on-field speed, energy use, and injury risk. While excess body fat reduces athletic performance by increasing locomotor energy consumption, appropriate body composition improves speed, agility, and endurance.(Corredor-Serrano et al., 2025; França et al., 2024; Toselli et al., 2022). Therefore, accurate measurement of anthropometric and physiological characteristics has become essential for monitoring training, assessing skills, and improving performance in soccer.

Assessment of young soccer players is important because this stage is crucial for physical growth, skill acquisition, and long-term athletic progression. During adolescence, players experience major physical and morphological changes that affect their playing abilities. Understanding these qualities enables coaches and sports scientists to create age-appropriate training plans and spot up-and-coming talent. Additionally, field-based assessments, including sprint tests, agility tests, vertical jump tests, flexibility tests, and occasional endurance tests (e.g., yo-yo tests), are useful and reliable indicators of a player's physical and physiological profile(Dugdale et al., 2019; Perroni et al., 2023; Trecroci et al., 2019). Despite extensive research on soccer performance, most studies have focused on elite or professional players and have not emphasized regional or population-based disparities among youth athletes. In countries like India, changes in location, climate, training facilities, and the availability of training can significantly impact the development of physical and physiological characteristics. For example, players from places with more structured training programs and facilities may perform better in terms of speed, agility and strength. People from different environmental backgrounds may have an advantage in aerobic capacity due to their lifestyles and habits(Martinho et al., 2024; Sannicandro et al., n.d.).

In this context, observing players from multiple perspectives can provide insight into how environmental, cultural, and training-related factors influence athletic performance. Kerala has excellent sports facilities and regular football training, which gives players more opportunities to train and learn. Lakshadweep is made up of islands, and different lifestyles and movements can affect athletic abilities. The study aims to determine how body size, body fat, and physical abilities such as running fast, changing direction, jumping, and being active for long periods differ across these locations. The study aims to determine how players perform across different areas, so coaches can better identify talented players, create more effective training plans, and help young football players improve.

RESEARCH METHODOLOGY

This study used a cross-sectional comparative approach to examine differences in physical and athletic abilities among young football players in Kerala and Lakshadweep. It included 200 boys aged between 15 and 17 from each location. (Kerala and Lakshadweep). All participants were competitive soccer players who were medically eligible to take a physical performance test. All individuals and their parents provided informed consent prior to participation. All evaluations were conducted in standard field settings using the same equipment and methodology. Before the test, the participants performed a fixed warm-up. Adequate recovery time was allowed between trials and test components to minimize fatigue effects. Trained professionals performed all measurements to ensure uniformity and reliability.

Standardized protocols were used to examine anthropometric characteristics and body composition, including body height, mass, and skinfold thickness at seven sites (triceps, biceps, subscapular, supraspinal, abdomen, thigh, and calf). The sum of these skinfolds was then used to estimate body fat percentage using proven predictive models.(Stomfai et al., 2011; Vážná et al., 2024). The Arrowhead Agility Test was used to test agility, with individuals performing trials in both directions and recording their best time.(Chalil et al., 2026; Rago et al., 2020). Speed and repeated sprint capacity were measured using a 30-m linear sprint test with split timings at 10 m, 20 m, and 30 m, followed by five repeated maximal 30-m sprints separated by 25 s of recovery; Fastest sprint time, total sprint duration, and fatigue index were recorded.(Kyles et al., 2023; Thurlow et al., 2023). Curvilinear sprint performance was assessed using a curve sprint test with several directional changes, with the fastest, mean, and fatigue indices recorded across multiple trials.(Altmann et al., 2019; Fílter et al., 2020). Lower-body explosive strength was measured using the vertical leap test, in which individuals performed three maximal attempts; the highest jump height was used to calculate peak power production using a validated prediction equation.(Harman et al., 1991; Mahar et al., 2022). Flexibility was tested using the sitting and reaching test, with the best result recorded in centimeters.(Petrigna et al., 2025). The Yo-Yo Intermittent Recovery Test Level 1 (Yo-Yo IR1) was used to assess intermittent aerobic fitness.(Bangsbo et al., 2008; Castagna et al., 2020). The total distance covered was recorded to compute maximal oxygen

uptake (VO_2max). In addition, intermittent endurance performance was assessed using the Yo-Yo Intermittent Endurance Test Level 1, with total distance serving as the primary outcome measure.(Kusuma et al., 2025).

Data were analyzed using appropriate statistical software. Descriptive statistics are presented as mean ± standard deviation (SD). Group differences between Kerala and Lakshadweep players were examined using independent samples t-tests. Statistical significance was set at $p < 0.05$.

II. RESULTS AND DISCUSSION

Table 1. Anthropometric and Body Composition Characteristics

Variable	Kerala (Mean ± SD)	Lakshadweep (Mean ± SD)	t-value	p-value
BMI (kg/m²)	19.81 ± 2.76	19.66 ± 3.13	0.35	0.72
Body Fat (%)	5.64 ± 1.96	5.97 ± 3.15	-0.88	0.37
Fat Mass (kg)	2.99 ± 1.16	3.00 ± 1.40	-0.09	0.93
Fat-Free Mass (kg)	49.94 ± 8.05	48.03 ± 10.46	1.45	0.14

No significant differences were observed between Kerala and Lakshadweep football players in BMI, body fat percentage, fat mass, or fat-free mass ($p > 0.05$). These findings indicate that both groups had comparable anthropometric and body-composition profiles.

Table 2. Physical Performance Variables

Variable	Kerala (Mean ± SD)	Lakshadweep (Mean ± SD)	t-value	p-value
Vertical Jump (cm)	46.74 ± 23.82	42.14 ± 7.18	1.84	0.06

Continuous……

Variable	Kerala (Mean ± SD)	Lakshadweep (Mean ± SD)	t-value	p-value
Peak Power (W)	1450.09 ± —	677.99 ± —	2.82	0.024*
Agility (s)	18.17 ± 0.79	18.43 ± 0.64	-2.55	0.00*
Linear Sprint (s)	13.88 ± 6.23	4.19 ± 0.61	14.19	0.00*
Curve Sprint (s)	7.32 ± 0.83	7.78 ± 0.55	-4.15	0.00*
Flexibility (cm)	68.07 ± 5.71	38.11 ± 6.46	34.70	0.00*

Significant between-group differences were identified in several physical performance variables. Kerala players demonstrated significantly better performance in peak power ($p = 0.024$), agility ($p < 0.001$), linear sprint ($p < 0.001$), curve sprint ($p < 0.001$), and flexibility ($p < 0.001$). No significant difference was observed in vertical jump performance ($p = 0.06$).

Table 3. Repeated Sprint and Fatigue Indices

Variable	Kerala (Mean ± SD)	Lakshadweep (Mean ± SD)	t-value	p-value
Fatigue Index (Linear Sprint)	0.03 ± 0.07	0.09 ± 0.07	-5.68	0.00*
Fatigue Index (Curve Sprint)	0.10 ± 0.32	0.08 ± 0.10	0.62	0.53

Kerala players exhibited a significantly lower fatigue index during the linear sprint test ($p < 0.001$), indicating superior repeated-sprint ability. However, no significant difference was found between groups in the fatigue index of the curve sprint test ($p > 0.05$).

Table 4. Endurance and Aerobic Capacity

Variable	Kerala (Mean ± SD)	Lakshadweep (Mean ± SD)	t-value	p-value
Yo-Yo IR1 Distance (m)	2.51 ± 726.41	2.15 ± 518.99	3.98	0.00*
Intermittent Exercise Capacity (m)	1.35 ± 509.14	9.94 ± 296.37	6.18	0.00*
VO_2max ($ml \cdot kg^{-1} \cdot min^{-1}$)	53.07 ± 5.71	54.51 ± 4.35	-2.01	0.046*

Kerala players showed significantly greater intermittent endurance capacity and intermittent exercise performance ($p < 0.001$). In contrast, Lakshadweep players demonstrated significantly higher VO_2max values ($p = 0.046$), indicating superior aerobic capacity

The study investigates variations in anthropometric factors, body composition, physical performance parameters (including agility, speed, power, and flexibility), and physiological capacity (intermittent endurance and aerobic fitness) of youth football players in Kerala and Lakshadweep, highlighting major differences and similarities in game performance. The study observed no significant variation in BMI, body fat percentage, fat mass, and fat-free mass. This study shows that players from both locations have similar physical characteristics, which coincides with a trend commonly observed among young soccer players. Teenagers who train regularly will have the lean body mass necessary to meet their athletic demands. However, it is important to understand that similar anthropometric profiles do not always result in the same performance, as neuromuscular efficiency, metabolic conditioning, and training methods all influence physical performance.

Contrary to the conclusions drawn from body measurements, several physical performance indicators showed positive changes. The athletes from Kerala performed well in speed, straight-line running, curve running, flexibility, and high energy predictability. Speed, the ability to slow down, and the ability to change direction are all important and always needed in football.The reason why Kerala bowlers bowl so well is their neuromuscular coordination and training methods that enable them to change direction towards the target quickly. Similarly, good sprint performance indicates good acceleration mechanics and muscular strength. Both are essential for efficient running, quick attacks, and improved defense. The high peak power that Kerala bowlers are likely to have indicates their ability and strength. Meanwhile, the difference in peak power across groups appears highly significant. This raises doubts about methodological issues or calculation errors. Such miscalculations are likely to mask true differences in neuromuscular ability. Hence, it is essential to examine these differences. When analyzing performance data, it is important to check that the prediction equations and measurement procedures are correct. Kerala athletes performed well in the seat-and-reach test, demonstrating that flexibility is essential.The high peak power of athletes in Kerala illustrates their strong, explosive athletic ability. Meanwhile, the differences in peak power across groups are large. This could be due to methodological problems, calculation errors, or changes in training methods. This may be due in particular to differences in systematic warm-up routines, stretching exercises, and methods of avoiding accidents. Individual flexibility increases comfort and functionality and reduces the risk of injury. Emphasis is placed on its development through intensive training methods. Lakshadweep players lack flexibility because they are either not selected or not selected adequately. The large differences between the individual groups trained exemplify this.

In a test of repeated-sprint ability, Kerala players demonstrated a significantly lower fatigue index in linear sprint tests. This shows a better ability to sustain performance during repeated high-intensity efforts.(Romero et al., 2025). Football players need to run with minimal recovery time throughout the match, so this one factor is an important aspect of their performance. Better repeated-sprint performance may be related to high-intensity interval training and sport-specific conditioning. However, there was no significant difference in the fatigue index of the curved sprint tests, suggesting that technical skill and experience with curved running may be required to succeed in more complex movement patterns.

Kerala athletes demonstrated well-defined high-interval tolerance (Yo-Yo IR1 distance) and interval workout capacity. These assessments are directly related to the football needs of. It assesses their ability to perform high-intensity tasks with minimal recovery periods. Higher scores on these tests indicate greater adaptability to repetitive workloads, mainly due to rigorous training methods that replicate competitive situations. This highlights the importance of sport-specific endurance training to improve competitive performance.

Lakshadweep players had significantly higher VO_2max values, indicating better aerobic capacity. The study found a significant difference between continuous aerobic fitness and endurance in intermittent sports. Football requires consistent, high-intensity work, although VO_2max is often tested during prolonged exercise. For players in Lakshadweep, the island's environmental and lifestyle changes, which include high levels of physical activity, help increase VO_2 max. These properties may help improve cardiac function even in the absence of regular physical exercise. However, the practical significance of this difference in VO_2 max needs careful evaluation. Although statistically significant, this difference between players is so small that it is unlikely to affect football matches. It highlights the need to use statistical methods and practical methods when studying physiological data. Similarly, increases in aerobic capacity may not always be associated with gains from specific training, but may lead to improved athletic performance.

The lack of a significant difference in vertical jump performance suggests that lower-body explosive power across the groups is approximately equal, in contrast to the difference observed in jump height. This may be because certain physical characteristics reach full growth more consistently in adolescents, or because they engage in activities that improve explosive power. For the Kerala group, the differences in vertical jump scores suggest we need better ways to measure and improve performance. The data suggests that the training environment and the amount of training influence how well athletes train. Regular training, effective training methods, and participation in competitions can help Kerala athletes become faster, more flexible, and, in some cases, more resilient. These are crucial for becoming stronger and more athletic. However, for the Lakshadweep athletes, their superior aerobic capacity (stamina) may not be due to hard training, but to how they live and the environment they live in.

Things like training, diet, growth, and the amount of money one has can influence how strong and skilled one becomes in a sport. However, in this study, they could not control or change those things. Athletes from Lakshadweep seem to be better at aerobic activities (like running and jumping), perhaps not just because of their training, but also because of where they live and their lifestyle. Differences in factors such as running time and maximum power mean we need to examine the data carefully to ensure it is accurate. So, future studies should follow people for longer periods to learn more about how they develop and how training and environment affect them over time. Other ways to see how good a player is, such as testing their strength, studying how their bodies move, and looking at game statistics, can help us understand them better. Future research could follow players over a longer period of time to understand how they develop and how training and environments affect them as they change.

CONCLUSION

This study was conducted to understand how the body composition and shape of young football players from Kerala and Lakshadweep differed and how they were similar. It was found that their body sizes and shapes were almost the same, so this does not explain why some players perform better than others. However, there are important differences in how well they play and their abilities. Athletes from Kerala excel in speed, sprinting (on straight and curved courses), flexibility, and, occasionally, endurance. They also exhibit a lower fatigue index across repeated sprints. These characteristics highlight the ability to perform high-intensity athletic activities, which are essential in soccer. Lakshadweep athletes exhibited higher VO_2max values, indicating greater aerobic capacity. However, this distinction is likely to have limited practical application in consecutive tournaments.

Findings indicate that gains in performance are largely related to training availability, coaching methods, and sport-specific fitness, rather than to anthropometric characteristics. These findings highlight the importance of systematic and structured training methods to improve speed, flexibility, repeated-sprint ability, and intermittent endurance among young soccer players. Meanwhile, environmental and lifestyle

factors may contribute to variations in aerobic fitness. Problems with some metrics, such as sprint performance and peak power, may be due to errors in data collection or calculations. So, it is important to handle this information carefully. Future research should use more precise assessment techniques and longitudinal studies. Furthermore, it is necessary to consider biological maturation, training experience, and socioeconomic conditions when examining the evolution of performance in youth soccer.

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